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NACHRON OPERATION BULLETIN ©

How to Operate Your NACHRON Timer/Controller*

*Patent Pending

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DESCRIPTION OF NACHRON

The NACHRON generates an accurately timed pulse upon stimulus from either a switch on the front panel or an external control signal. This pulse is either dc, with an amplitude of -6 volts, or ac, with an amplitude and frequency equal to the input power line voltage. The pulse can be used to start and stop a process or equipment. Either phase of signal is available; for example, the ac signal can be either on or off during the pulse.

The NACHRON can also be operated as a repetitive pulse train generator. In this mode, the interval between pulses is accurately timed by the NACHRON, with no "first-cycle" effect. The width of the pulses is adjusted by means of an external capacitor.

The NACHRON was selected as one of the 100 most significant new technical products of 1966, by Industrial Research's 30-man editorial advisory board, which includes Nobel laureates and leading industrial, government, and university scientists, engineers, and administrators. Its 1000 minute range represents a breakthrough by several orders of magnitude past 5 minutes, which was previously regarded as the limit on "RC" timers.

HOW TO OPERATE YOUR NACHRON

Setting Up

1. Connect the left-hand receptacle to 115 volts 60 Hz. power by means of the line cord furnished with the equipment. Turn the NACHRON on and observe that the REPEATING-SINGLE DELAY switch lights up.

2. Push the switch to the SINGLE DELAY position and release it to the center position.

3. Turn the FULL SCALE RANGE switch to the 10 SEC position.

4. Reach in back and feel for the right-hand slide switch. Push it to the left.

60 Hz. Output

Reach in back and feel for the middle slide switch. Push it up and the 60 Hz. power will be off during the delay interval. Push it down and the power will be on during the delay interval. Power is taken from the female receptacle to the right of the line cord. This power is fused at 3 amperes to protect the silicon controlled rectifiers.

Plug a 115 v. a. c. load (we will assume it is a lamp) into the receptacle. It will turn on or not depending upon the position of the middle slide switch. Now press the SINGLE DELAY to start the delay interval, during which your lamp turns on (or off).

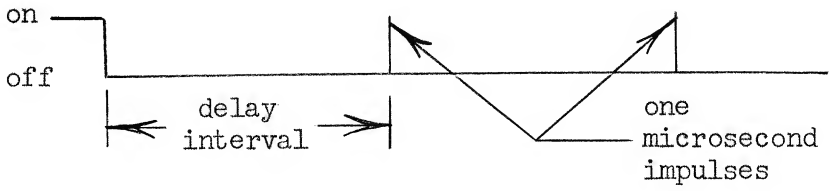
Adjusting Delay

Turns of the TIME dial are counted by the number in the little window in the top, 0 to 9. Each turn is divided into hundredths by the markings on the TIME dial. If you turn the TIME dial to turn number 9, then continue clockwise until the TIME dial reads 99 and then 0, the number in the little window will flip to 0. At this point the TIME setting is maximum and equal to the FULL SCALE RANGE setting.

The delay may be reduced to any value less than the FULL SCALE RANGE setting. For example, to set a delay of 24 seconds, set the FULL SCALE RANGE to 100 seconds, the number in the window to 2, and the dial to 40. This setting is read as .240 which if multiplied by the FULL SCALE RANGE of 100 seconds, gives the time as 24 seconds. Or, to set a delay of 0.4 minutes, set the FULL SCALE RANGE to 1 minute, the number in the window to 4, and the dial to 0. This setting is read as .400 which if multiplied by 1 minute, gives the time as .4 minutes.

Repetitive Cycling

Reach in back and push the middle slide switch up, so that the lamp is on when the interval ends. Now push the switch to the REPEATING position. You just started a delay and the lamp turned off. At the end of this delay the NACHRON will automatically restart a second delay, and generate an impulse with a duration of 1 microsecond.



Return the switch to the center position. At the end of the current delay interval the lamp comes on and remains on until you start a new delay interval.

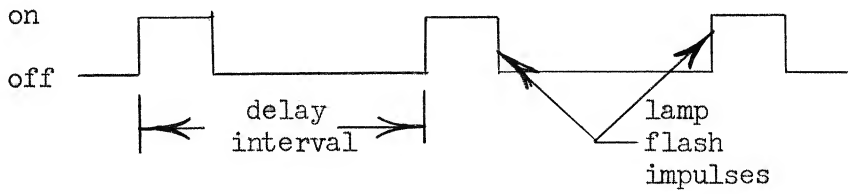
Adjusting Pulse Width

The impulse at the end of each delay interval in repetitive cycling may be made longer; long enough, for example, so that the lamp flashes after each delay interval. To do this you must connect a capacitor between pins 4 and 8 on the terminal board on the back of the NACHRON. The terminals number 18 in all. Observing from the back, terminal 1 is on the right, 18 on the left.

Be sure the NACHRON is off while you are connecting the capacitor. If you use an electrolytic capacitor be sure that its rating is at least 5 volts, and connect the negative end to pin 4. It requires approximately 80 microfarads to generate a time interval of 1 second. This time interval is not precise. To generate a precise pulse width requires a second NACHRON (see Ganging Two NACHRONs, page 8).

Alternative Repetitive Cycling Mode

Press the switch to SINGLE DELAY and let it spring to neutral again. Now, at the end of the durrent delay interval, the lamp turns on and remains on. Now reach in back and push the right-hand slide switch to the right, and the lamp goes out. Wait for a period of time equal to the length of a delay interval, then push the switch to the REPEATING position. The lamp flashes, and at the beginning of each delay interval it flashes again. Press the switch down to neutral, and the lamp remains off after the delay interval ends.



Your NACHRON will not operate in SINGLE DELAY with the right-hand slide switch in this position; you must restore it to the left-hand position.

Externally Controlling Your NACHRON

Connect a wire between the START and GND binding posts. Flip the switch to REPETITIVE. Nothing happens, because the REPEATING-SINGLE DELAY switch is disabled. Leave it in the REPEATING position and briefly remove the wire from the binding post and restore it. This starts a delay interval. If the wire is left off, a second delay interval starts immediately following the first; in other words, repetitive cycling occurs. You may control your NACHRON by your wire, by a contact closure, or by an electrical signal applied to the START binding post.

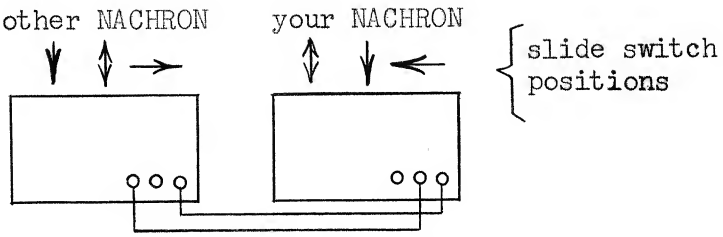
If you use an electrical signal to control your NACHRON, be sure that it varies between zero and a negative voltage of between 6 and 30 volts, and be sure that your electrical signal can furnish 2.5 milliamperes of current at between 0 and -0.5 volts.

DC Output

Either polarity of dc output is available, at the DELAY binding post. It is selected by means of the slide switch in back, on the left-hand side as viewed from the front. If the switch is pushed up, the voltage is negative during the delay interval; if down it is at ground potential during the delay interval.

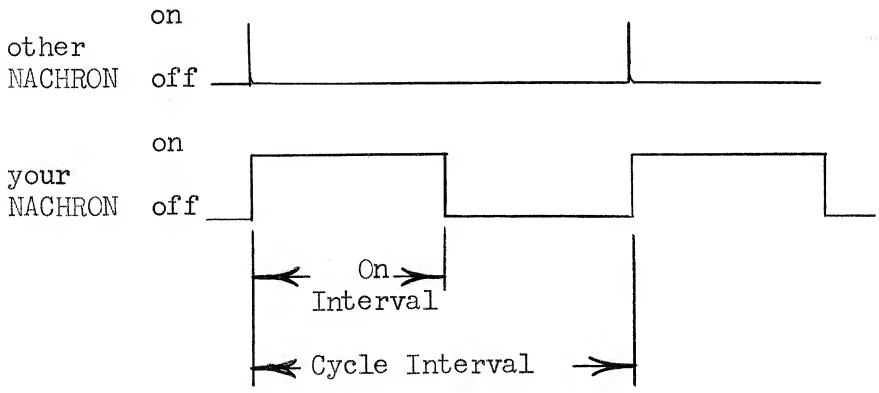
The dc outputs are available unswitched at the terminal board on the back of the NACHRON, at pins 4 and 6, counting from the right as you look from the back. Pin 4 is at ground potential during the delay interval. The switched dc level, which connects to the DELAY binding post, is at pin 5.

Ganging Two NACHRONs



You can control your NACHRON from another NACHRON, simply by connecting a wire from the DELAY binding post of the other NACHRON to the START binding post of your NACHRON, and another wire between the GND binding posts of both. Reach in back and feel for the left-hand slide switch of the other NACHRON and push it down; push the right-hand slide switch to the right. On your NACHRON, push the right-hand slide switch to the left , and put it in the REPEATING condition.

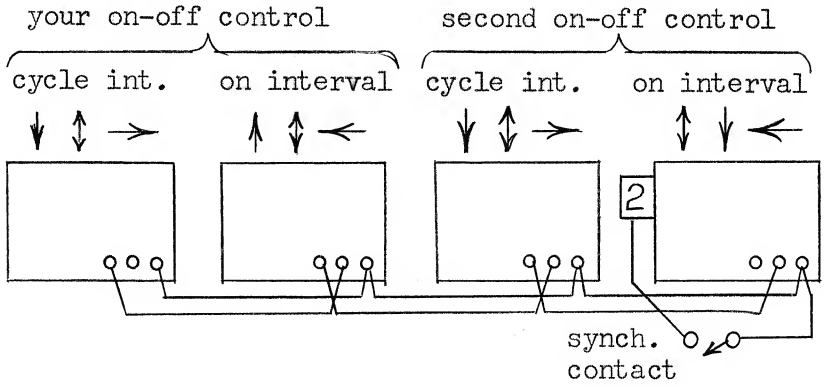
Now. put the other NACHRON in the REPEATING condition; each time it repeats a delay interval it will start a delay interval in your NACHRON. If your NACHRON is still in a delay interval nothing happens; you will want to adjust your NACHRON to a shorter interval than the other NACHRON so that it will already have finished its delay interval when the next signal comes from the other NACHRON.



Now you have a complete on-off control. The other NACHRON controls the cycle interval, and your NACHRON controls the on interval.

Ganging Two On-Off Controls

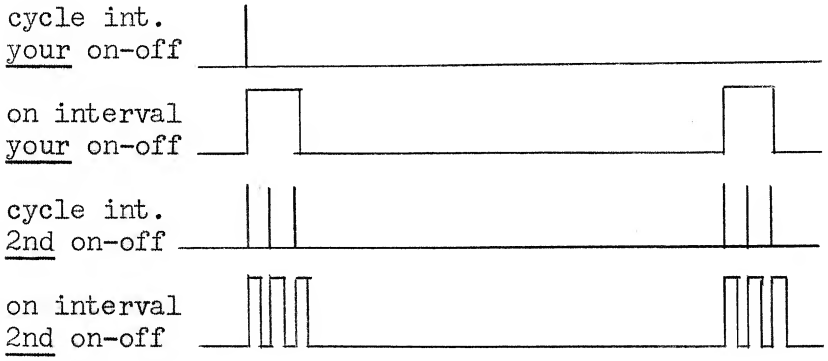
In the medical application of "sighing" a patient in a respirator automatically, the nurse will normally, every hour or so, cause an excess amount of air to inspire into the lungs. In a Bird respirator this is accomplished by holding the respirator in the inhalation phase for more than the normal length of time. In a Bennett respirator, the pressure is increased for a few extra breaths, causing extra air to be inhaled. Either of these two actions may be performed by a solenoid actuator controlled by the 60 Hz. output from the on interval NACHRON of a second on-off control which is ganged to your on-off control.



Your on-off control should be adjusted so as to turn on the second on-off control every gour or so. To do this, connect a wire between the GND binding posts of the two on-off controls, and a second wire from the DELAY binding post of the on interval NACHRON of your on-off control to the START binding post of the cycle interval NACHRON of the second on-off control.

Ganging Two On-Off Controls (Cont.)

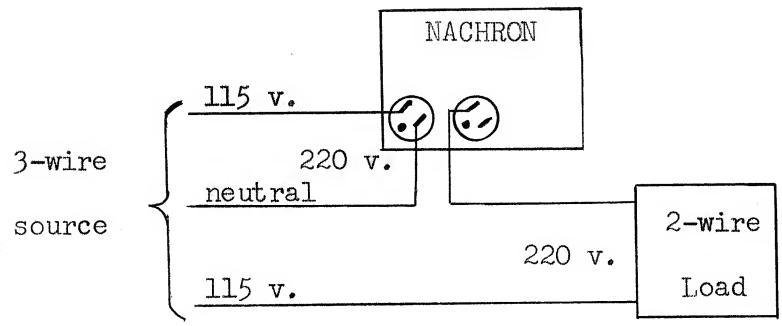
Push the left-hand switch on the back of the on interval NACHRON of your on-off control up so that its output is positive during its on interval. Put the cycle interval NACHRON of the second on-off control into the REPEATING condition. The cycle is started by putting the cycle interval NACHRON of your on-off control into the REPEATING condition.



The 60 Hz. output from the on interval NACHRON of the second on-off control may be used to control a solenoid which holds the respirator in the exhalation phase to automatically sigh the patient. Normally, this waits until the patient is already in the exhalation phase, for a synchronizing switch holds the NACHRON from starting until the respirator is exhaling the patient. Connect this contact between GND and pin 2 on the terminal board on the back of the NACHRON, counting from the right. Turn the NACHRON off while you are making connections to the terminal board.

Controlling 220 v. 60 Hz. (Three-Wire Source)

You may control a 220 volt load from a 115-0-115 volt three-wire source with your NACHRON. To do this you must carefully observe the polarity of the connections to your NACHRON:



The "hot" wire (often colored black) must go to the top blade of the left-hand receptacle, leaving the neutral to go to the right-hand blade of the left-hand receptacle. The load connects between the other "hot" wire (which does not connect to the NACHRON) and the top blade of the right-hand receptacle. This connection will work only with a two-wire load, or with a three-wire load where the neutral is used only for grounding the frame or case.

Five Percent Precision

Your NACHRON will operate with 5% accuracy if used as described previously, with CALIBRATION set to 50.0. This is determined by the accuracy of the RC elements which determine the time.

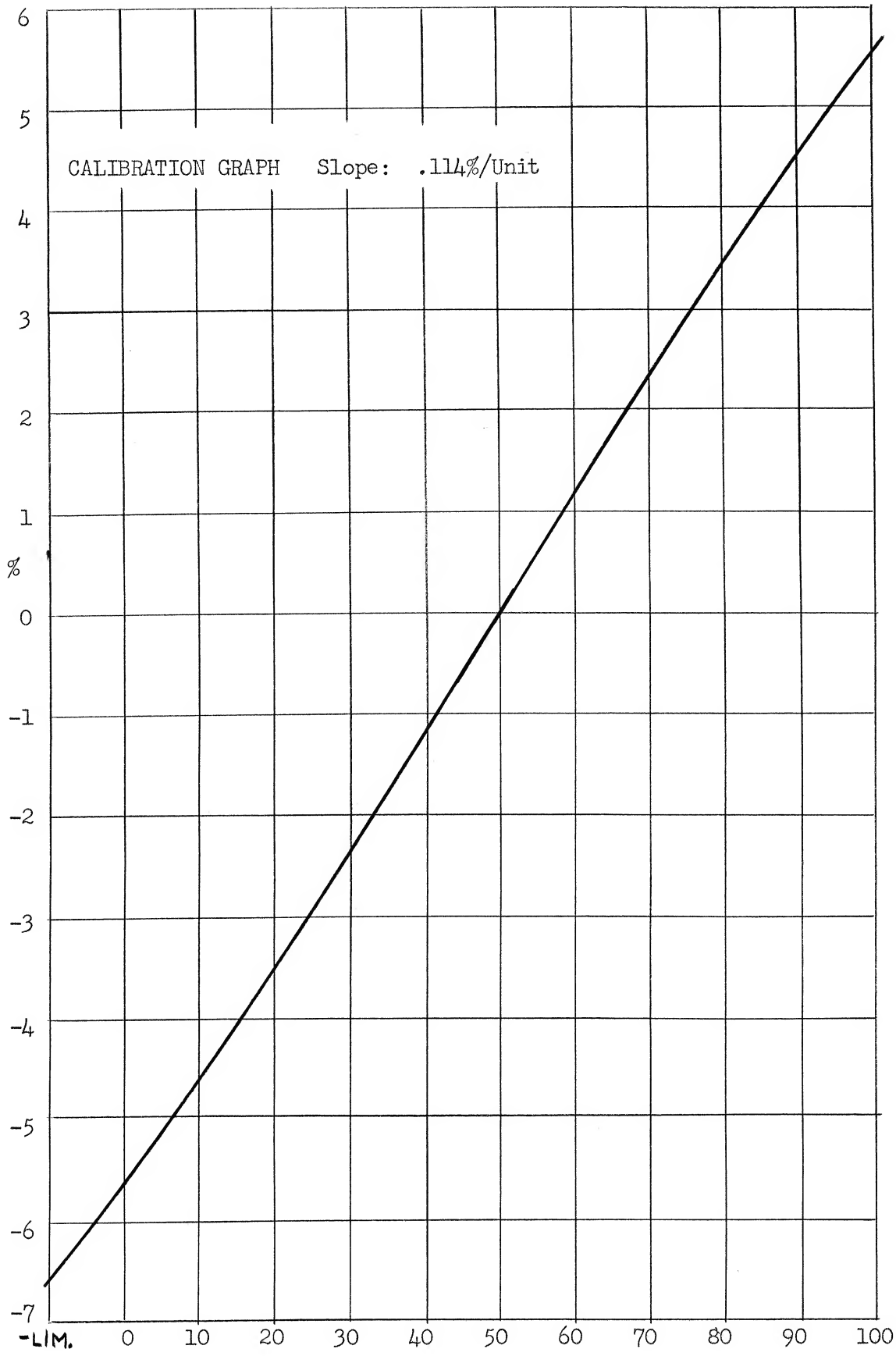
One-Half Percent Precision

You may obtain ½% setting accuracy of your NACHRON simply by setting the CALIBRATION to compensate for the imprecision of the RC elements. A separate calibration setting is used for each FULL SCALE RANGE position. To determine the CALIBRATION setting, do the following:

Set the NACHRON to the maximum TIME setting or to a particular TIME setting of interest for the FULL SCALE RANGE which you have selected. Start the NACHRON by depressing to the SINGLE DELAY position, and measure the actual time which your NACHRON generates. Compute from this the percentage change to make it correspond to the TIME setting; if the actual time is above the TIME setting, this change has a negative value, otherwise positive. Now, find this percent on the Calibration Graph, and determine the Calibration Setting corresponding to this percent. This is the particular setting of the CALIBRATION which you should use for this FULL SCALE RANGE position; write it into the little window on the front panel corresponding to the dot that the FULL SCALE RANGE switch points to.

You may wish to check to see whether you wish to further refine the CALIBRATION setting. If you compute small increments of correction, use the factor 0.114% per Calibration Setting unit, which is the slope of the Calibration Graph. Simply divide this factor into the percent error to arrive at an increment of change you should make in the Calibration Setting.

The accuracy of your NACHRON is now determined primarily by the non-linearity of the TIME setting potentiometer.


CALIBRATION GRAPH Slope: .114%/Unit
6
5
4
3
2
1
%
0
-1
-2
-3
-4
-5
-6
-7
-LIM.
0
10
20
30
40
50
60
70
80
90
100
Calibration Setting

One-Tenth Percent Precision

The timing reproducability is ±1/10% rms, and so it is possible to obtain this order of accuracy with your NACHRON. To do this it is no longer sufficient to have only one CALIBRATION setting for each position of the FULL SCALE RANGE switch. You must calibrate it for several settings (on every rotation where the dial reads 0, for example). Make several measurements at each setting, and take the average value for the true time at that setting.

To maintain 1/10% accuracy, you must maintain the temperature of your NACHRON constant within a few degrees centigrade, and we recommend you regulate the line voltage as well.

How to Measure the Time of the NACHRON

Obtaining ½% and 1/10% precision with your NACHRON as outlined above, requires that you measure the NACHRON's time interval with an elapsed time meter. the simplest elapsed time meter is an ordinary electric clock with a sweep second hand, which you can use if you have an accurate and stable line frequency, as most areas have, and if you restrict its use to time intervals of one minute or greater. At shorter times the starting and stopping times of the clock make its validity questionable, and a commercial elapsed time meter must be used. This device, which consists of a crystal oscillator, gate, and counter, is available in many electronic development and standards laboratories.

To use an electric clock, merely plug the clock into the right-hand 60 Hz. receptacle, set the middle slide switch down, and the right-hand slide switch to the left. Set the clock so that all three hands point to 12, and start the NACHRON. The clock starts and runs throughout the delay interval, then stops. The time is taken directly from the clock.

To use the elapsed time meter (often called a Time and Frequency Meter) you must connect DELAY and GND to the input and ground points of the meter, and operate it according to its instructions.

NACHRON
SOLID-STATE
Timer / Controller

FEATURES...

- All Silicon Circuitry – No Tubes or Relays
- Single or Repetitive Cycle
- Accuracy Calibratable to 0.1%
- Independent of Line Frequency
- Insensitive to Temperature
- Silicon Controlled Rectifier–Controlled Output
- Insensitive to Electrical Noise
- Timing Less Than a Second to 16 2/3 Hours
- Single or Repetitive Cycle
- Gangable to Another Timer

FRONT PANEL CONTROLS

Single-Cycle/Repetitive Switch
Time Vernier Potentiometer
Full Scale Range Switch: 10 & 100 SEC.; 1, 10, 100 & 1000 MIN.
Calibration Potentiometer

REAR PANEL CONTROLS

Slide Switches: Output On/Off During Delay
D. C. Ganging Output 0.1/6.0 Volts During Delay

USES...

NUCLEAR TIMING
CONTINUOUS CYCLING
SAMPLE CHANGING
STARTING-STOPPING EXPERIMENTS
LABORATORY
MEDICAL

SPECIFICATIONS...

Input Volts: 115 @ 50/60 Hz.
A.C. Output: 115/230 Volts at 3.0 Amperes
D.C. Input/Output: 0.1 to 6 Volts Negative
Timing Reproducability: Below 0.1% Full Scale RMS.
Timing Linearity: ± 0.3%
Temperature Coefficient: ± .02% Per Degree; 25 to 70 Centigrade
Size: 6'' x 7'' x 10''
Weight: 6 lbs.

Price: $495.00 FOB. New Haven

Price and Specifications Subject to Change Without Notice.

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